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PTO/SB/05 (2/98)

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UTILITY  
PATENT APPLICATION  
TRANSMITTAL

Attorney Docket No.

4015-755

First Inventor or Application Identifier

Ali

Title

INVERTED-F ANTENNA FOR FLIP-STYLE MOBILE  
TERMINALS

Express Mail Label No.

EL659735207US

(Only for new nonprovisional applications under 37 CFR § 1.53(b))

## APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

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Box Patent Application  
Washington, DC 20231

1. ☒ \*Fee Transmittal Form (e.g., PTO/SB/17)  
(Submit an original and a duplicate for fee processing)
2. ☒ Specification [Total Pages 16]  
(preferred arrangement set forth below)  
— Descriptive title to the Invention  
— Cross References to Related Applications  
— Statement Regarding Fed sponsored R & D  
— Reference to Microfiche Appendix  
— Background of the Invention  
— Brief Summary of the Invention  
— Brief Description of the Drawings (if filed)  
— Detailed Description  
— Claim(s)  
— Abstract of the Disclosure
3. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 5]
4. ☒ Oath or Declaration [Total Pages 3]  
a. ☒ Newly executed (original or copy)  
b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))  
(for continuation/divisional with Box 17 completed)  
[Note Box 5 below]  
i. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting  
inventor(s) named in the prior application,  
see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference (useable if Box 4b is checked)  
The entire disclosure of the prior application, from which a  
copy of the oath or declaration is supplied under Box 4b,  
is considered as being part of the disclosure of the  
accompanying application and is hereby incorporated by  
reference therein.

6. ☐ Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission  
(if applicable, all necessary)  
a. ☐ Computer Readable Copy  
b. ☐ Paper Copy (identical to computer copy)  
c. ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

8. ☒ Assignment Papers (cover sheet & document(s))
9. ☐ 37 C.F.R. § 3.73(b) Statement ☒ Power of Attorney  
(when there is an assignee)
10. ☐ English Translation Document (if applicable)
11. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☒ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)  
(Should be specifically itemized)
14. ☐ \*Small Entity Statement filed in prior application,  
Statement(s) Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)  
(if foreign priority is claimed)
16. ☒ Other: Express Mail Certification

\*NOTE FOR ITEMS 1 & 14: IN ORDER TO BE  
ENTITLED TO PAY SMALL ENTITY FEES, A SMALL  
ENTITY STATEMENT IS REQUIRED (37 C.F.R.  
§ 1.27), EXCEPT IF ONE FILED IN A PRIOR  
APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information below and in a preliminary statement:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: \_\_\_\_\_ / \_\_\_\_\_  
Prior application information: Examiner: Group/Art Unit:

## 18. CORRESPONDENCE ADDRESS

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NAME

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STATE

ZIP CODE

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Name (Print/Type)

Taylor M Davenport

Registration No. (Attorney/Agent)

42,466

Signature

Taylor M. Davenport

Date

9/22/00

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**FEE TRANSMITTAL**

Patent fees are subject to annual revision on October 1

These are the fees effective December 29, 1999.

Small Entity payments must be supported by a small entity statement.  
otherwise large entity fees must be paid. See Forms PTO/SB/09-12.

See 37 C.F.R. §§ 1.27 and 1.28.

Complete if Known

**TOTAL AMOUNT OF PAYMENT** \$958.00

Application Number	TBA
Filing Date	TBA
First Named Inventor	Ali
Examiner Name	TBA
Group Art Unit	TBA
Attorney Docket No.	4015-755

**METHOD OF PAYMENT (check one)**

- 1.
- ☒
- The Commission is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number

18-1167

Deposit Account Name

Coats &amp; Bennett, P.L.L.C.

☒ Charge Any Additional Fee Required Under 37 CFR §§1.16 and 1.17☐ Charge the Issue Fee Set in 37 CFR §1.18 at the Mailing of the Notice of Allowance

- 2.
- ☒
- Payment Enclosed:

☒ Check ☐ Money Order ☐ Other**FEE CALCULATION****1. BASIC FILING FEE**

Large Fee Code	Entity Fee (\$)	Small Fee Code	Entity Fee (\$)	Fee Description	Fee Paid
101	690	201	345	Utility filing fee	690.00
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	760	208	380	Reissue filing fee	
114	150	214	75	Provisional filing fee	
<b>SUBTOTAL (1)</b>					<b>\$690.00</b>

**2. EXTRA CLAIM FEES**

	Extra Claims	Fee from below	Fee Paid
Total Claims	24	-20** = 4	X 18 = 72
Independent Claims	5	-3** = 2	X 78 = 156
Multiple Dependent Claims		X	

\*\* or number previously paid, if greater; For Reissues, see below

Large Fee Code	Entity Fee (\$)	Small Fee Code	Entity Fee (\$)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim
109	78	209	39	**Reissue independent claims over original patent
110	18	210	9	**Reissue claims in excess of 20 and over original patent

**FEE CALCULATION (continued)****3. ADDITIONAL FEES**

Large Fee Code	Entity Fee (\$)	Small Fee Code	Entity Fee (\$)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examination action	
115	110	215	55	Extension for reply within first month	
116	380	216	190	Extension for reply within second month	
117	870	217	435	Extension for reply within third month	
118	1,360	218	680	Extension for reply within fourth month	
128	1,850	228	925	Extension for reply within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,210	241	605	Petition to revive - unintentional	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt.	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40.00
146	760	246	380	Filing a submission after final rejection (37 CFR 1.129(a))	
149	760	249	380	For each additional invention to be examined (37 CFR 1.129(b))	
Other fee (specify)					
Other fee (specify)					
*Reduced by Basic Filing Fee Paid					
<b>SUBTOTAL (3)</b>					<b>\$40.00</b>

**SUBMITTED BY**

Typed or Printed Name Taylor M. Davenport

Signature

Date

7/22/00

Complete (if applicable)

Reg. Number 42,466

Deposit Account User ID 18-1167

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )  
)  
David M. McMahon )  
)  
Serial No. \_\_\_\_\_ )  
)  
Filed: \_\_\_\_\_ )  
)  
For: INVERTED-F ANTENNA FOR FLIP-STYLE )  
MOBILE TERMINALS )  
)  
)  
Attorney's Docket No. P-4015.755 )

**Express Mail Certification**  
**Label No.EL659735207US**

Raleigh, North Carolina

September 21, 2000

Assistant Commissioner for Patents

**BOX PATENT APPLICATION**

Washington, D.C. 20231

Sir:

**EXPRESS MAIL CERTIFICATE LABEL NO. EL659735207US**

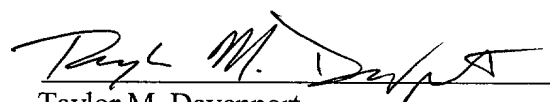
**DATE MAILED: September 21, 2000**

I hereby certify that the enclosed Utility Patent Application Transmittal, Fee Transmittal Form (2 copies), specification and claims, drawings (1 set of 5 sheets), Declaration and Power Of Attorney, Assignment and Recordation Sheet, Information Disclosure Form and related document and our Check # 2601 in the amount of \$958.00, are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. §1.10 on the date indicated above and is addressed to Assistant Commissioner for Patents, BOX PATENT APPLICATION, Washington, D.C. 20231.

Respectfully submitted,

**COATS & BENNETT, P.L.L.C.**

By:

  
Taylor M. Davenport  
Registration No. 42,466

Telephone: (919) 854-1844

Express Mail Label No.: EL659735207US

Date Mailed: September 22, 2000

# **UNITED STATES PATENT APPLICATION FOR GRANT OF LETTERS PATENT**

**Mohammad Ali  
INVENTOR**

## **INVERTED-F ANTENNA FOR FLIP- STYLE MOBILE TERMINALS**

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## **INVERTED-F ANTENNA FOR FLIP-STYLE MOBILE TERMINALS**

### **BACKGROUND OF THE INVENTION**

The present invention is directed to an antenna for use in a mobile terminal and particularly to an auxiliary antenna for use in a mobile terminal.

5 Mobile terminals, such as cellular phones, pagers, personal digital assistants, and the like have exploded into the public's consciousness. One recent innovation pioneered by a consortium of mobile terminal manufacturers is a communication technology called Bluetooth that operates in the ISM band at 2.4 to 2.485 GHz in the electromagnetic spectrum. Mobile terminals are being adapted to incorporate this technology. Mobile terminals are also being adapted to operate with position detection systems, such as the Global Positioning System (GPS). GPS operates at 1.57542 GHz.

10 Due to the fact that these technologies operate at frequencies different from those normally associated with wireless communications, mobile terminals need additional, or at least different, antennas to function properly with these technologies.

### **BRIEF SUMMARY OF THE INVENTION**

15 The present invention comprises using a mechanical hinge in a flip or clam-shell style mobile terminal as an inverted-F antenna for auxiliary communication purposes such as with a Bluetooth transceiver or a GPS receiver. In one embodiment, a first part of the hinge (a first hinge plate) is attached to the signal line of the RF printed circuit board of the mobile terminal by a fastener such as a screw. A second screw adjacent to the first screw is attached between the ground of the RF printed circuit board and the hinge. Together the first part and the two screws form an inverted-F antenna. A second part of the hinge (a second hinge plate) is coupled to the

first part and forms the remainder of the mechanical hinge. In some embodiments, meanders are used to lengthen the electrical length of the first part so as to achieve an optimal operating frequency.

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## **BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 illustrates a communication environment that may include a wireless network for use with the present invention;

Figure 2 illustrates a mobile terminal that may be adapted for use with the present invention;

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Figure 3 illustrates a perspective view of a flip-type mobile terminal suitable for use with the present invention;

Figure 4 illustrates one embodiment of an antenna constructed according to the present invention; and

Figure 5 illustrates a second embodiment of an antenna with meanders constructed according to the present invention.

## **DETAILED DESCRIPTION OF THE INVENTION**

The present invention is directed to an improved antenna arrangement in flip-type mobile terminals. In particular, the present invention provides an inverted F-antenna integrated into a hinge. A “hinge” as used herein includes both hinge plates and pivot area. It should be appreciated that while the hinges illustrated herein include a pin as the pivot, they may also be living hinges if needed or desired. This additional antenna allows the mobile terminal to

communicate at another frequency while allowing isolation between the antennas of the mobile terminal to reduce crosstalk and other electromagnetic interference.

As illustrated in Figure 1, a communication environment 10 may include a mobile network 40, a location detection network 70, and a Bluetooth network 80. A mobile terminal 100 may be positioned in one or more of these networks.

Mobile network 40 may comprise, amongst other elements, an MSC 42 and a base station 50. MSC 42 may be communicatively coupled to the Public Switched Telephone Network (PSTN) 20 or other mobile networks 40 within the Public Land Mobile Network (PLMN, not shown) as is conventional. The operation of mobile network 40, and mobile terminal 100 within the mobile network 40, are well documented in various standards such as TIA/EIA-136, Digital Advance Mobile Phone Service (D-AMPS), European Total Access Communication System (ETACS), Code Division Multiple Access (CDMA), Global System for Mobile Communication (GSM), Pacific Digital Cellular (PDC), and the like, the standards and documentation of which are herein incorporated by reference.

Location detection network 70 may be a satellite-based system, a terrestrial system or some hybrid thereof. Location detection network 70 is illustrated as a satellite system comprising one or more satellites 72. The most common location detection system is the Global Positioning System (GPS), although the Russian equivalent, GLONASS, is another option. Other systems may likewise be available. Typically, satellites 72 communicate with mobile terminals 100 over a different frequency than that on which the mobile terminals 100 communicate with the mobile network 40. For example, GPS satellites communicate at 1.57542 GHz. The GPS standards are partially publicly available at

<http://www.navcen.uscg.mil/pubs/gps/icd200/icd200c.pdf> and are hereby incorporated by reference.

Bluetooth network 80 may comprise a Bluetooth enabled computer 82 or other Bluetooth enabled device such as another mobile terminal 100, a vehicle or the like as needed or desired.

5 Bluetooth is well documented at [www.bluetooth.com](http://www.bluetooth.com). In particular, the specifications, volumes 1 and 2 are hereby incorporated by reference in their entirety. These are publicly available at <http://www.bluetooth.com/developer/specification/specification.asp>. Bluetooth communications likewise communicate with mobile terminals 100 over a different frequency than that on which the mobile terminals 100 communicate with the mobile network 40. In particular, Bluetooth  
10 enabled devices communicate at approximately 2.4 GHz in the ISM band.

The present invention is adapted for use in the mobile terminal 100 to enable mobile terminal 100 to communicate with the various networks within communication environment 10. However, a more complete understanding of the mobile terminal 100 may be helpful. Turning now to Fig. 2, a block diagram of a mobile terminal 100 is illustrated. Mobile terminal 100  
15 typically includes a controller 122, an operator interface 126, a transmitter 138, a receiver 150, and a primary antenna assembly 158. Operator interface 126 typically includes a display 128, keypad 130, interface control 132, microphone 134, and a speaker 136. Display 128 allows the operator to see dialed digits, call status, and other service information. Keypad 130 allows the operator to dial numbers, enter commands, and select options. Interface control 132 interfaces  
20 the display 128 and keypad 130 with the controller 122. Microphone 134 receives acoustic signals from the user and converts the acoustic signals to an analog electrical signal. Speaker 136 converts analog electrical signals from the receiver 150 to acoustic signals that can be heard by the user.



The analog electrical signal from the microphone 134 is supplied to the transmitter 138. Transmitter 138 includes an analog to digital converter 140, a digital signal processor 142, and a phase modulator and RF amplifier 148. Analog to digital converter 140 changes the analog electrical signal from the microphone 134 into a digital signal. The digital signal is passed to the digital signal processor (DSP) 142, which contains a speech coder 144 and channel coder 146. Speech coder 144 compresses the digital signal and the channel coder 146 inserts error detection, error correction and signaling information. DSP 142 may include, or may work in conjunction with, a DTMF tone generator (not shown). The compressed and encoded signal from the digital signal processor 142 is passed to the phase modulator and RF amplifier 148, which are shown as a combined unit in Figure 2. The modulator converts the signal to a form that is suitable for transmission on an RF carrier. RF amplifier 148 then boosts the output of the modulator for transmission via the primary antenna assembly 158.

Receiver 150 includes a receiver/amplifier 152, digital signal processor 154, and a digital to analog converter 156. Signals received by the primary antenna assembly 158 are passed to the receiver/amplifier 152, which shifts the frequency spectrum, and boosts the low-level RF signal to a level appropriate for input to the digital signal processor 154.

Digital signal processor 154 typically includes an equalizer to compensate for phase and amplitude distortions in the channel corrupted signal, a demodulator for extracting bit sequences from the received signal, and a detector for determining transmitted bits based on the extracted sequences. A channel decoder detects and corrects channel errors in the received signal. The channel decoder also includes logic for separating control and signaling data from speech data. Control and signaling data are passed to the controller 122. Speech data is processed by a speech decoder and passed to the digital to analog converter 156. Digital signal processor 154, may

include, or may work in conjunction with, a DTMF tone detector (not shown). Digital to analog converter 156 converts the speech data into an analog signal that is applied to the speaker 136 to generate acoustic signals that can be heard by the user.

Together, the transmitter 138 and the receiver 150 are referred to herein as a voice  
5 communication transceiver.

Primary antenna assembly 158 is connected to the RF amplifier of the transmitter 138 and to the receiver/amplifier 152 of the receiver 150. Primary antenna assembly 158 typically includes a duplexer 160 and an antenna 162. Duplexer 160 permits full duplex communications over the antenna 162.

10 Controller 122 coordinates the operation of the transmitter 138 and the receiver 150, and may for instance take the form of a typical microprocessor. This microprocessor may be a dedicated or shared microprocessor and may be a single processor or multiple parallel processors as needed or desired. This coordination includes power control, channel selection, timing, as well as a host of other functions known in the art. Controller 122 inserts signaling messages into  
15 the transmitted signals and extracts signaling messages from the received signals. Controller 122 responds to any base station commands contained in the signaling messages, and implements those commands. When the user enters commands via the keypad 130, the commands are transferred to the controller 122 for action. Memory 124 stores and supplies information at the direction of the controller 122 and preferably includes both volatile and non-volatile portions. It  
20 is expected that controller 122 and memory 124 as well as many of the other processing components described herein will be positioned on a printed circuit board 190 (Figure 4) as is conventional.

In addition to the above-described elements, the mobile terminal 100 may also include a location detector 164 in communication with the controller 122. Location detector 164 may have its own antenna 300 discussed below. Location detector 164 may be a Global Positioning System (GPS) receiver or other satellite or terrestrial system as needed or desired. Typically, the location detector 164 will output a geocoordinate expressed as longitude, latitude, and, optionally, altitude coordinates corresponding to the present location of the mobile terminal 100.

Mobile terminal 100 may also include a Bluetooth module 168 together with Bluetooth antenna 200. Bluetooth is discussed above and reference is made thereto. Bluetooth module 168 is designed to comply with the standards set forth for Bluetooth and enable wireless communication at approximately 2.4 GHz between Bluetooth enabled devices. Controller 122 may control Bluetooth module 168 as needed or desired.

As noted, various antennas may be associated with the mobile terminal 100. Antennas operate most efficiently when they are one quarter the length of the signal desired to be received. Thus, to facilitate proper communication in a mobile terminal 100 amongst the various networks 40, 70, and 80, it may be desirable to have three different antennas. Further, many mobile terminals 100 are already designed to operate in two or three modes so as to communicate with different mobile networks 40 that may employ different standards alternatively requiring more antennas. Typically, a mobile terminal 100 may operate at one or more of the following frequency ranges: 824 –894 MHz, 880-960 MHz, 1710-1880 MHz, and 1850-1990 MHz, depending on which standards with which it complies.

It is known to add antennas having the desired length to mobile terminals 100 to add additional functionality. However, these additional antennas require additional circuitry and additional space in or about the mobile terminals. Further, the antennas must be separated

sufficiently to insure proper mutual isolation so as to reduce crosstalk or other forms of electromagnetic interference. While filters can be used to reduce crosstalk, filters for closely spaced antennas tend to be bulky and relatively expensive to achieve the performance required. Alternatively a “window” may be created which allows an internally positioned antenna to communicate through the body 170 (Fig. 3) of the mobile terminal 100. However, this imposes additional undesirable constraints on circuit board design. Thus, for antennas for Bluetooth or GPS applications, especial care must be taken to not interfere with the primary cellular antenna assembly 158.

A mobile terminal 100 incorporating the present invention is illustrated in a perspective view in Figure 3. Mobile terminal 100 is a flip-type or clamshell-type mobile terminal having a body 170 and a flip portion 180 hingedly connected one to the other by hinges 172 and 174. It should be appreciated that in some embodiments, only one hinge 172 may connect the flip portion 180 to the body 170. Display 128 may be mounted on the mobile terminal 100, and, in this case, on the flip portion 180. However, it should be appreciated, that in some mobile terminals 100, such as a cellular phone, the flip portion 180 may have no additional components. Mobile terminal 100 may also comprise a keypad 130, a microphone 134 and a speaker mounted on body 170. Again, it should be appreciated that some or all of these components instead could be mounted on the flip portion 180 if needed or desired. Primary antenna assembly 158 is shown as a stub antenna, but may include other classes of external or internal antennas designed to operate at conventional cellular frequencies or the like.

It should be appreciated that the term “mobile terminal” may include a cellular radiotelephone with or without a multi-line display; a Personal Communications System (PCS) terminal that may combine a cellular radiotelephone with data processing, facsimile and data

communications capabilities; a PDA that can include a radiotelephone, pager, Internet/intranet access, Web browser, organizer, and/or calendar; and a conventional laptop and/or palmtop receiver or other appliance that includes a radiotelephone transceiver. Mobile terminals may also be referred to as "pervasive computing" devices. Thus, while the present discussion may be couched in terms of a phone and/or a laptop computer, the present invention is equally applicable to these other sorts of devices. The previous discussion was by way of example, and not intended to be limiting on the definition of a mobile terminal.

The present invention uses hinges 172 and/or 174 to act as the antennas for location detector 164 and/or the Bluetooth module 168. While such applications may be of primary commercial importance at the present time, it should be appreciated that an antenna created within the hinges 172 or 174 may equally be adapted for other purposes or devices within the mobile terminal 100, such as Asia's i-Mode, another frequency antenna to make the mobile terminal 100 dual-mode or even tri-mode, or the like as needed or desired. Further, in mobile terminals 100 that include two hinges 172, 174, both hinges may be changed to antenna hinges according to the present invention. For example, a first hinge 172 could be adapted for Bluetooth performance and a second hinge 174 adapted for GPS reception. Other permutations on this concept will be readily apparent to those of ordinary skill in the art.

Figure 4 illustrates a first embodiment of the present invention. In particular, a hinge, for the purposes of illustration, hinge 172, connects the flip portion 180 to the body 170 of the mobile terminal 100. Hinge 172 is formed from two parts, a first part 202 and a second part 204. In the event the flip portion 180 includes a display 128, hinge 172 is constructed to allow a flex-film line (constructed of a suitable polyimide material) to carry signals to the display from the body 170 and particularly from the controller 122 on the printed circuit board 190.

First part 202 is spaced from and attached to the printed circuit board 190 by two fasteners 206 and 208 respectively. Together, the first part 202 and the fasteners 206, 208 form an inverted-F antenna. Suitable fasteners include screws or the like. Thus, the shank of the screw may space the first part 202 from the printed circuit board 190. One fastener 206 acts as a connection to the ground plane of the printed circuit board 190. The other fastener 208 acts as the RF feed for the antenna 200, connecting antenna 200 to the appropriate circuitry on the printed circuit board 190 such as the location detector 164 or the Bluetooth module 168. Note that choosing which fastener acts as the ground connection and which acts as the RF signal connection is well understood. It should be appreciated that the ground feed and the RF feed could alternatively be provided by another structure that does not fasten the antenna 200 to the printed circuit board and that the antenna 200 may be held in place by fastening the antenna 200 to the body 170 of the mobile terminal 100. It should be appreciated that the first part 202 and the fasteners 206 and 208 need to be capable of receiving electromagnetic signals, and thus are likely to be metal. Further, the spacing of the fasteners 206, 208 may be varied to achieve impedance matching or otherwise improve performance.

While dimensions of the hinge 172 are not critical to the present invention, sample appropriate dimensions are as follows: first part 202 length 25 mm, height 4 mm, and width 5 mm; second part 204 length 30 mm, height 0.02 mm, and width 7 mm. In general, the size of the two parts 202 and 204 will be dictated by the mechanical strength requirements of the hinge 172.

Angle  $\Theta$  represents the angle between first part 202 and second part 204. In one embodiment, antenna 200 should function as desired regardless of the angle  $\Theta$ . This, however, may be somewhat dependent upon the operating frequency of the antenna 200.

A second embodiment is illustrated in Figure 5. In this embodiment, especially adapted for GPS reception, antenna 300 comprises a first part 302 and a second part 304. Similarly to the previous embodiment, one fastener (not shown) may connect part 302 to the signal line of the RF printed circuit board and another fastener (not shown) may connect the ground of the RF printed circuit board to part 302 is required. This has been achieved here using plates 320, 322 respectively as illustrated. Note that plate 320 may be thicker than plate 322. First part 302 includes a meander 310 to make it electrically longer without changing the axial length of the first part 302. Second part 306 may likewise be coated with a plastic film so as not to short out the meanders 310 when the hinge 172 is in a closed position. For a further discussion of meander antennas in the field of mobile terminals, reference is made to application serial number 09/089,433, which is hereby incorporated by reference in its entirety. Alternatively, a film may be positioned atop meanders 310 to perform the same function. Other alternate techniques to isolate the parts 304 and 306 may also occur to those of ordinary skill in the art.

The present invention may, of course, be carried out in other specific ways than those herein set forth without departing from the scope and the essential characteristics of the invention. The present embodiments are therefore to be construed in all aspects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

## CLAIMS

What is claimed is:

1. A mobile terminal comprising:

a body;

5 a flip portion; and

a hinge connecting said body to said flip portion, said hinge comprising an antenna for use by an electronic circuit positioned within said mobile terminal.

10 2. The mobile terminal of claim 1 wherein said antenna is an inverted-F antenna.

3. The mobile terminal of claim 1 wherein said antenna is operative at frequencies between 2.4 and 2.485 GHz.

15 4. The mobile terminal of claim 1 wherein said antenna operates within the ISM band.

5. The mobile terminal of claim 1 wherein said antenna receives a GPS signal.

6. The mobile terminal of claim 1 further comprising a second hinge forming a second antenna.

20 7. The mobile terminal of claim 6 wherein said first antenna is adapted for use at frequencies ranging from 2.4 to 2.485 GHz and said second antenna is adapted for receiving a GPS signal.



8. The mobile terminal of claim 1 further comprising a printed circuit board adapted to hold said electronic circuit.

9. The mobile terminal of claim 8 further comprising a fastener attaching said antenna to said printed circuit board.

10. The mobile terminal of claim 9 wherein said fastener is a screw.

11. The mobile terminal of claim 10 further comprising a second fastener attaching said antenna to said printed circuit board.

12. The mobile terminal of claim 11 wherein one of said fasteners acts as a connection to ground for said antenna and the other of said fasteners acts as an RF feed for said antenna.

13. A method of constructing a mobile terminal, comprising:  
positioning a printed circuit board in the mobile terminal;  
fastening an antenna to said printed circuit board; and  
using said antenna as a hinge for a flip portion of said mobile terminal.

14. The method of claim 13 wherein fastening an antenna to said printed circuit board comprises fastening an inverted-F antenna to said printed circuit board.

15. The method of claim 13 further comprising receiving and transmitting Bluetooth communications through said antenna.

16. The method of claim 13 further comprising receiving a GPS signal through said antenna.

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17. The method of claim 13 wherein fastening an antenna to said printed circuit board comprises using a first fastener as a connection to ground and using a second fastener as an RF feed.

18. The method of claim 13 further comprising opening and closing said hinge during operation of the mobile terminal.

19. A mobile terminal comprising:

a body;

a printed circuit board positioned inside said body;

a flip portion; and

a hinge, said hinge forming an inverted-F antenna and hingedly securing said flip portion to said body, said hinge electrically coupled to said printed circuit board.

20. The mobile terminal of claim 19 further comprising a voice communication transceiver and

a second antenna adapted for use with said voice communication transceiver, said voice communication transceiver positioned within said body, and said second antenna spaced from said inverted-F antenna.

21. A method of constructing a mobile terminal, comprising:

connecting a flip portion to a body portion of the mobile terminal using a hinge that also comprises an antenna.

5 22. A mobile terminal comprising:

a body;

a printed circuit board positioned within said body;

electronic circuitry positioned on said printed circuit board;

at least one antenna for voice communications at a first operating frequency, said at least

10 one antenna operatively connected to said electronic circuitry;

a flip portion;

a hinge comprising an auxiliary antenna connecting said flip portion to said body, said  
antenna operatively connected to said electronic circuitry, said auxiliary antenna for  
communication at a second operating frequency.

15 23. The mobile terminal of claim 22 wherein said auxiliary antenna comprises a GPS receiver  
antenna.

20 24. The mobile terminal of claim 22 wherein said auxiliary antenna comprises a bluetooth  
antenna.

A flip or clam-shell style mobile terminal comprises a mechanical hinge that doubles as an inverted-F antenna for auxiliary communication purposes such as with a Bluetooth transceiver or a GPS receiver.

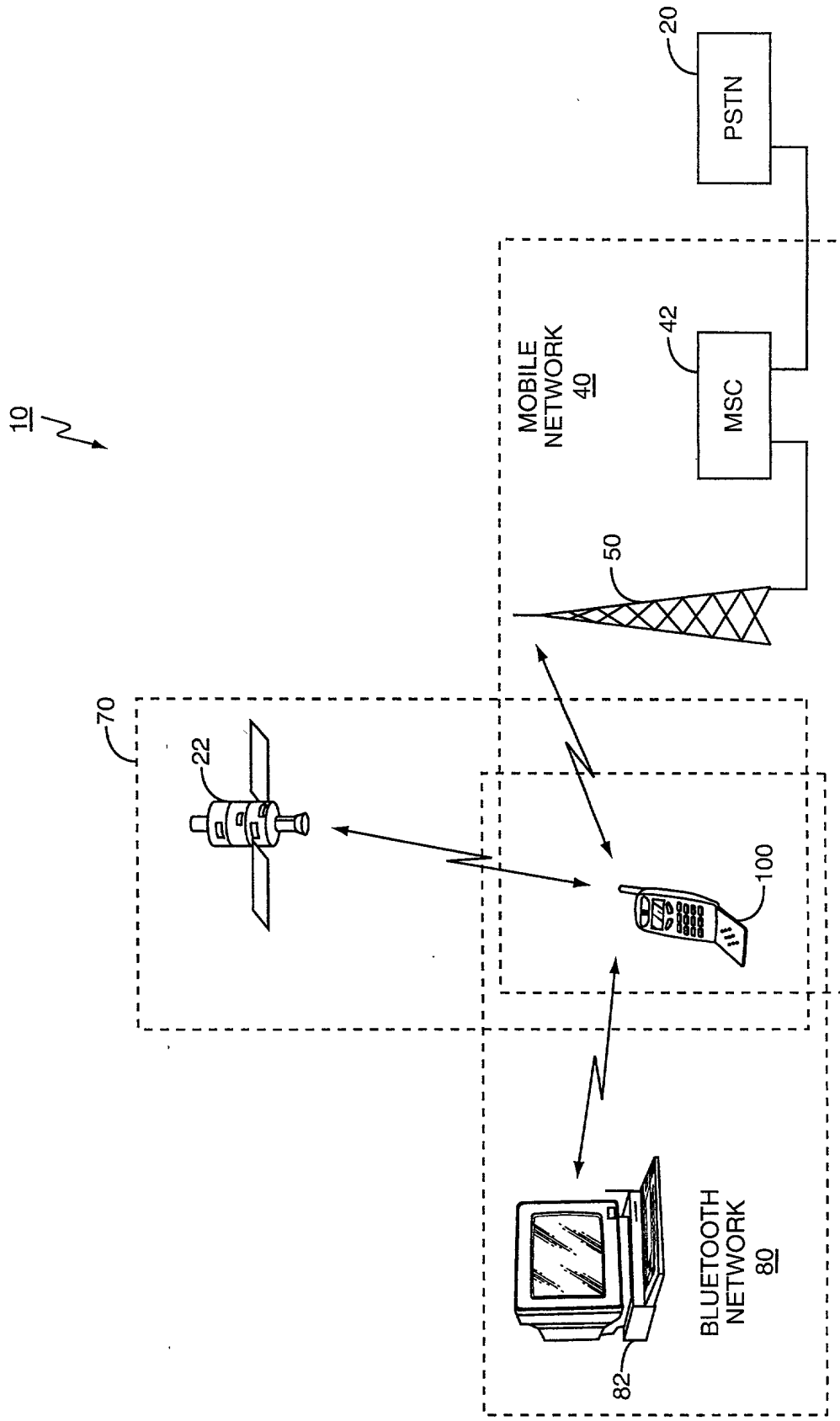


FIG. 1

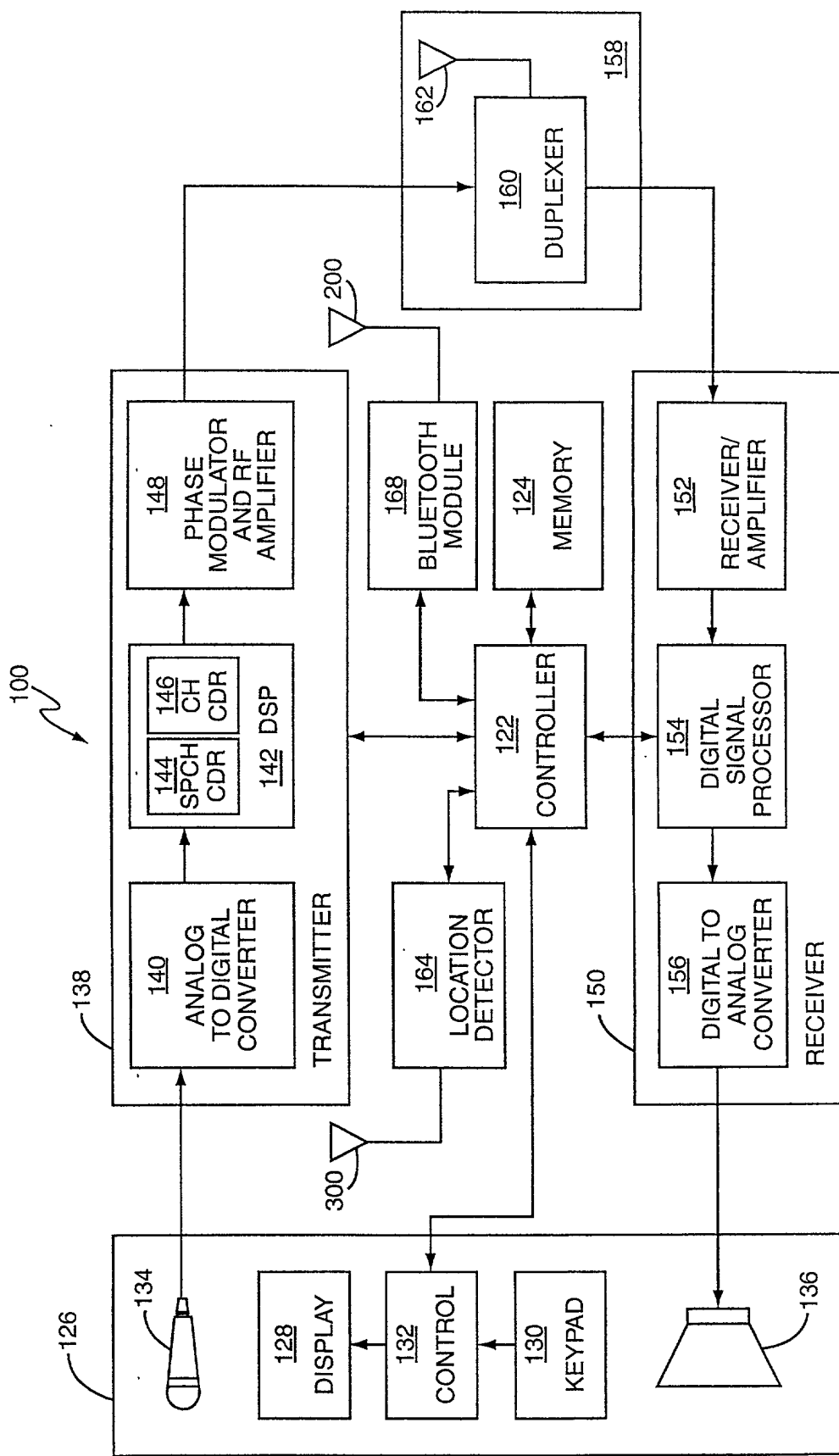
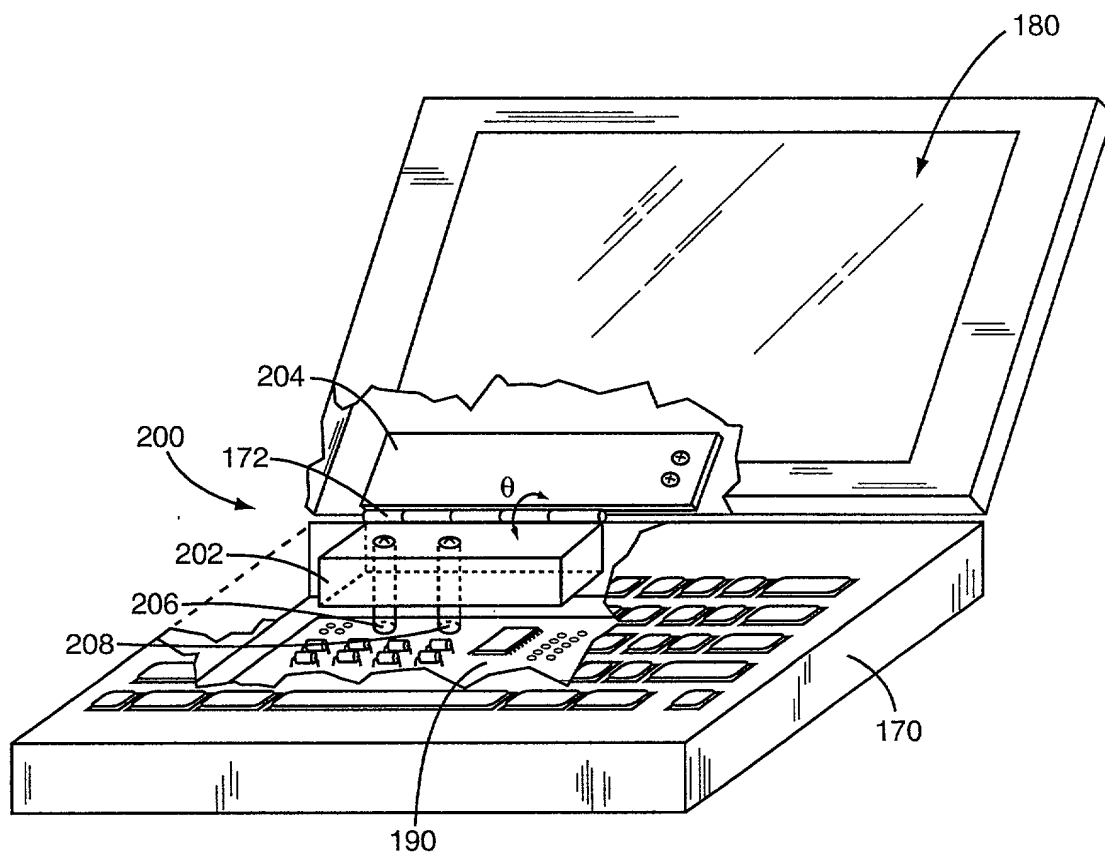


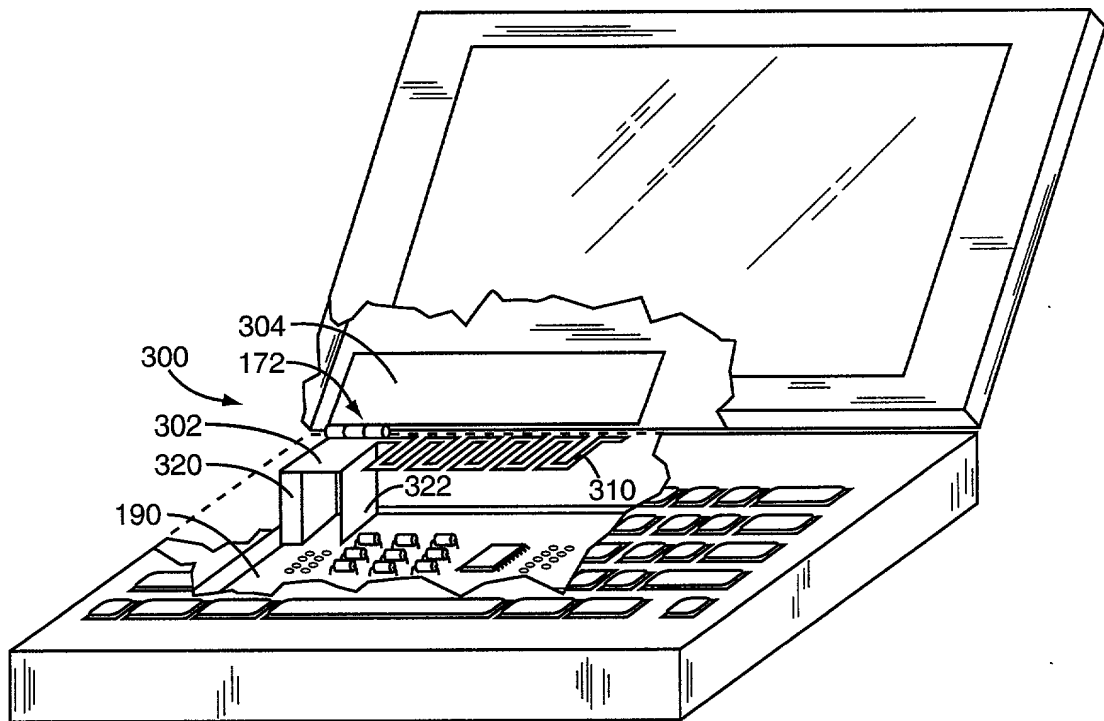
FIG. 2

100



**FIG. 4**





**FIG. 5**

## Declaration and Power of Attorney for Patent Application

As below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe that I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **INVERTED-F ANTENNA FOR FLIP-STYLE MOBILE TERMINALS**, the specification of which

☒ [ X ] is attached hereto.

(Check one)

☐ [ ] was filed on \_\_\_\_\_ as  
Application Serial Number \_\_\_\_\_  
and was amended on \_\_\_\_\_  
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me which is material to patentability (as defined in C.F.R. §1.56) in connection with the examination of this application.

I hereby claim foreign benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

NONE			[ ]	[ ]
(Number)	(Country)	(Day/Month/Year Filed)	YES	NO
_____	_____	_____	[ ]	[ ]
(Number)	(Country)	(Day/Month/Year Filed)	YES	NO
_____	_____	_____	[ ]	[ ]
(Number)	(Country)	(Day/Month/Year Filed)	YES	NO

## Declaration and Power of Attorney for Patent Application

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

NONE

(Application Serial No.)

(Filing Date)

(Status: Patented/Pending/Abandoned)

(Application Serial No.)

(Filing Date)

(Status: Patented/Pending/Abandoned)

**Power of Attorney:** As a named inventor, I hereby appoint the following agents/attorneys to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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## Declaration and Power of Attorney for Patent Application

And I also hereby appoint the Attorneys and Patent Agents of **Coats & Bennett, P.L.L.C.**, as identified by **Customer Number 24112** in the records of the United States Patent and Trademark Office and as updated from time to time, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.



Send Correspondence to: Taylor M. Davenport

Direct Calls to: Taylor M. Davenport

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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